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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/713,879	11/13/2003	Ansheng Liu	42P17910	1108

7590 08/31/2006

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EXAMINER	
CHIEM, DINH D	
ART UNIT	**PAPER NUMBER**
2883	

DATE MAILED: 08/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/713,879	LIU ET AL.	
	Examiner	Art Unit	
	Erin D. Chiem	2883	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 June 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. 8/15/06
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to amendment filed June 02, 2006. Currently claims 1-27 are pending.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1, 8, and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the claim limitations are misleading and inconsistent with the drawings. For example, claim 1:

(Currently Amended) An apparatus, comprising:

a buried tapered waveguide disposed in a semiconductor layer; and

a tapered rib waveguide disposed in the semiconductor layer proximate to the buried tapered waveguide, the tapered rib waveguide including a rib portion adjoining a slab portion, the slab portion of the rib waveguide adjoining the buried tapered waveguide, the buried tapered waveguide being beneath the slab portion of the tapered rib waveguide, wherein an optical beam is directed into a larger end of the buried tapered waveguide and the tapered rib waveguide, the buried tapered waveguide tapered to guide the optical beam therethrough into the slab portion of the rib waveguide, wherein a vertical height of the buried tapered waveguide at the larger end and at a smaller end opposite the larger end are substantially similar.

From the Fig. 1, it appears the buried tapered waveguide and the tapered rib waveguide are the same waveguide, but are claimed as physically different waveguides and the separation of the buried tapered waveguide and the tapered rib waveguide is the portion that is above the slab and the portion that is below the slab. Wherein it is well known in the art that the buried tapered waveguide and the tapered rib waveguide are physically and materially different.

Furthermore, the recitation "...wherein the vertical height of the buried tapered waveguide at the larger end and at a smaller end opposite the larger end are substantially similar" relates to the clarity issue above. Since light is input from the rectangular portion of the waveguide and the separation of the buried tapered waveguide and tapered rib waveguide is a linguistic distinction, thus, claiming the vertical height being "substantially similar" is misleading.

For the reasons provided above, examiner maintains the same art rejection as prior office action as provided herein below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-13 and 14-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jeon et al. (US Patent 6,174,748 B1, Jeon hereinafter) in view of Yamamoto et al. (US 6,030,540, Yamamoto hereinafter).

Regarding claims 1, and 8-13 Jeon teaches an apparatus comprising a buried taped waveguide, referring to Fig. 2, reference number 14A, disposed in a semiconductor layer 10, and a tapered rib waveguide disposed in a semiconductor layer 29, the tapered rib waveguide including a rib portion adjoining a slab portion 16A, the slab portion of the rib waveguide adjoining the buried tapered waveguide. As to the direction of the input light, Jeon teaches the apparatus is bidirectional wherein the coupling of input light is dependent on whether the user wishes to transform a large mode to a single mode or vice versa. Different mode coupling is performed by the tapering region wherein the light traveled through the larger or smaller end of the mode converter, when the light reaches the tapering region the two different modes are coupled together and then passed on through to either a larger mode or a smaller mode (col.1, line 49-61). With regard to the lateral tapering of the rib waveguide, please the lateral tapering progression of elements 16A and 14A in Fig. 2.

Regarding claims 2-5, the first and second cladding layers are a part of the semiconductor substrates made of indium phosphide layers (col. 3, line 22-27) wherein cladding layers are laterally grown onto the semiconductor substrate for the purpose of confining lights within the active light guiding layers. The buried tapered waveguide is also insulated within the cladding layers. See Fig. 2 for further details.

Regarding claims 14-15, Jeon discloses the method of making a dual tapered waveguide. The etching process begins with etching on a semiconductor wafer (Fig. 3A) through the first mask 31 and the etching of the buried taper waveguide is via a second mask 32 having a larger width end 36 and a smaller width end 34; growing an insulating layer about 100nm to 200 nm thick of SiO_2. The etching process is then patterned the tapered rib waveguide in the silicon

grown over the buried tapered waveguide such that a slab portion of the tapered rib waveguide adjoins the buried tapered waveguide having a larger end and a smaller end (Abstract and (col. 7, line 55 – col. 8, line 13)).

However, Jeon does not explicitly teach the "vertical height of the buried tapered waveguide at the larger end and at a smaller end opposite the larger end are substantially similar."

In teaching the method for producing tapered waveguide, Yamamoto demonstrated the improvement of his invention over the prior art (Figure 5A-5I). Yamamoto showed that by removing the mask 53 at a predetermine rate, a vertical tapering is formed versus the prior art that maintain the mask 53 such that there is no vertical tapering. Yamamoto's purpose for forming the vertical tapering is to further narrow the mode field on one end of the waveguide. However, when the vertical element of the mode field is not required to be converted then one of ordinary skill may retain the mask 53 and maintain a substantial similar height for the buried waveguide.

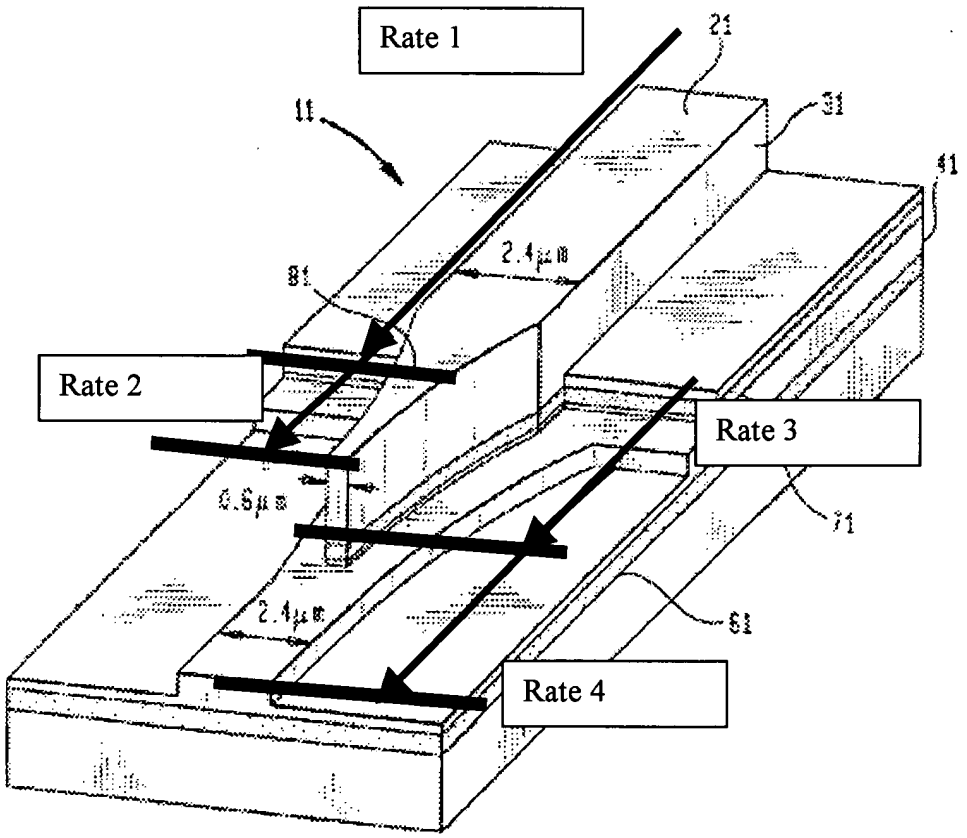
Since Jeon and Yamamoto are from the same field of endeavor, the purpose disclosed by Yamamoto would have been recognized in the pertinent art of Jeon.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to maintain or remove the mask 53, as taught by Yamamoto. **The motivation** for removing the mask 53 is to keep the height at the substantially same height when the vertical element of the mode field is not critical or the mode field conversion requirement is not as stringent.

Claims 6, 7, 10, 11, 16, 17-19, 26 and 27 rejected under 35 U.S.C. 103(a) as being unpatentable over Jeon and Yamamoto as applied to claims 1, 9, and 14 above, and further in view of Forrest et al. (US 6,819,814 B2 "Forrest" hereinafter).

Together Jeon and Yamamoto discloses the invention of claims 1, 9, and 14 (see rejection above); however, Jeon and Yamamoto do not *explicitly* disclose the various defined tapering region and tapering rates.

FIG. 4



Forrest's purpose for providing twin tapering waveguide such that when the waveguide is operated as a traveling-wave optical amplifier (TWA), there are paths for multiple passes to remove the even modes (col. 2, lines 40-48).

Since Jeon, Yamamoto, and Forrest are from all from the same field of endeavor, the purpose disclosed by Yamamoto and Forrest et al. would have been recognized in the pertinent art of Jeon and Yamamoto.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to recognize the various tapering region can be provided by various sized masks used during etching to vary the tapering rates as taught by Forrest. **The motivation** for varying the tapering regions as taught by Forrest is the need for removal of mode interference during coupling and the tapering method discloses by Forrest is most cost effective since the waveguide is fabricated on a single epitaxial structure.

Claims 22-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jeon in view of Yamamoto and Soljacic et al. (US 2003/0031443 A1).
Jeon et al. teach a mode converter comprising a semiconductor substrate having dual tapered waveguides wherein there are regions of tapering having different tapering rates such that multi mode signal can be converted to single mode signal and vice versa.

However, Jeon does not explicitly the vertical height of the buried waveguide is substantially the same nor does Jeon teach a system having an optical transmitter to transmit and optical beam and an optical receiver, nor does Jeon et al. explicitly disclose a photonic device optically coupled to the smaller end of the taper rib waveguide from the transmitter by the optical signal to be directed from the tapered rib waveguide through the photonic device to the optical receiver.

In teaching the method for producing tapered waveguide, Yamamoto demonstrated the improvement of his invention over the prior art (Figure 5A-5I). Yamamoto showed that by

removing the mask 53 at a predetermine rate, a vertical tapering is formed versus the prior art that maintain the mask 53 such that there is no vertical tapering. Yamamoto's purpose for forming the vertical tapering is to further narrow the mode field on one end of the waveguide. However, when the vertical element of the mode field is not required to be converted then one of ordinary skill may retain the mask 53 and maintain a substantial similar height for the buried waveguide.

Soljacic et al. teach coupling the tapered waveguide as a mode size converter to any optical devices such as a photonic integrated circuit (Fig. 21). Soljacic et al. further defines the coupling of tapered waveguide and a photonic integrated circuit as a bi-stable device since the efficiency confine the signal mode by converting a large mode field to a smaller mode field or vice versa enhances the axial confinement and the radial confinement of the optical signal, thereby, one can form optical cavities having high Q values and/or small modal volumes in the waveguides [0013]. Soljacic et al. further applied the bi-stable device as being applicable as an optical regenerator wherein the optical receiver sends its electrical output into an optical transmitter and the transmitter then relay a new optical signal into the fiber. Optical regenerator are used in long-haul transmission applications to remove unwanted effects such as dispersion, nonlinearities, and noise or any other effects that could corrupt the optical signal. When applying the bi-stable device into the optical regenerator, Soljacic et al. demonstrated the all optical signal output from the optical regenerator having definitively two states, high and low (Fig. 42).

Since Jeon, Yamamoto, and Soljacic et al. are from all from the same field of endeavor, the purpose disclosed by Yamamoto and Soljacic et al. would have been recognized in the pertinent art of Jeon.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to provide a mean to control mode field conversion. By removing the mask, the mode field size may further be reduced in the vertical dimension or one of ordinary skill may choose to maintain the mask and substantially keep the same height for the buried waveguide when the conversion requirement is not as stringent. Also, it would have been obvious to replace the tapered waveguide used by Soljacic et al. with a dual tapered waveguide taught by Jeon et al. to increase the coupling capability of various optical devices since a dual tapered waveguide may couple an input having any mode field size to one end and efficiently converting the mode such that coupling to the photonic integrated circuit is possible. Furthermore, one of ordinary skill in the art would know how to apply a taper waveguide as taught by Jeon or Yamamoto in an integrated system. The motivation for coupling the taper waveguide in an integrated system would have been for increasing the flexibility of optical elements that may be coupled to the bi-stable device needed in the long-haul transmission taught by Soljacic et al., since coupling different mode fields is made possible by the bi-stabile device, such that an all-optical output will definitively output only two states, high and low, that makes the transmission truly digital.

Response to Arguments

Applicant's arguments filed June 2, 2006 have been fully considered but they are not persuasive.

Applicant's only argument is the burred tapered waveguide (14a), disclosed by Jeon, is above the "backbone" layer (22).

Examiner's response to the argument is applicant's argument is a linguistic one. Firstly, in the original claim applicant only recited the "buried tapered waveguide" is adjoining the slab portion; Jeon met the originally recited limitation. Secondly, in view of the new amended limitation, Jeon's layer (28) may be considered the slab portion, thus layer (14A) would be adjoining the slab portion ***and*** buried below the slab portion.

For purposes of condensed prosecution, examiner advised applicant in the telephonic interview to reconsider amending the independent claims to expressly claim the invention, which is the first tapering in the horizontal direction from the light input end to the distal end and the second tapering in the vertical direction from the rib portion to the buried portion. Also, examiner advised applicant to not to be linguistically misleading with regards to the commonly known terms of "rib waveguide" and "buried waveguide."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erin D. Chiem whose telephone number is (571) 272-3102. The examiner can normally be reached on Monday - Thursday 9AM - 5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank G. Font can be reached on (571) 272-2415. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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